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BTS1518 – TEST REPORT: TR150414-3

Flatwise Tensile Strength of Kapo Board Adhered to EPS and XPS with Uroxsys' Panel Laminating Adhesive.

1. OBJECTIVE:

- 1.1. BEAL Testing Services were contracted by MAXRaft and Enviro Square Limited to verify that, when installed according to the supplier's instructions, Uroxsys' Panel Laminating Adhesive (PLA) will provide a satisfactory bond between Kapo Board and MAXRaft E (MRE – An EPS), as well as Kapo Board and MAXRaft X (MRX – An XPS).
- 1.2. Testing was carried out to assess the adhesive strength of Uroxsys' Panel Laminating Adhesive (PLA) to the Kapo Board, MRE and MRX substrates, in addition to this, adhesion strength to Kapo Board and MRE was assessed after freeze-thaw conditioning.

2. METHODOLOGY:

- 2.1. Test Method:
ASTM C297 – Standard Test Method for Flatwise Tensile Strength.

3. CRITERIA:

- 3.1. The adhesive strength of the product being tested to the nominated substrate shall be a minimum of 0.5 MPa in order to be deemed satisfactory OR the adhesive strength of the product being tested shall exceed the internal bond strength of the substrate(s) it is adhered to.

4. SAMPLE PREPARATION:

- 4.1. Samples were prepared according to the supplier's instructions and were approximately 35000 mm² in area. Samples were brushed clean of any dust before application of the PLA. The PLA was applied to the MRE/MRX substrate with a 1.5 mm trowel and then pressed onto the back side of a segment of Kapo Board – Water mist was not used on any substrate. A ~8 kg mass was then laid on the sample to provide compression.

Note: Previous samples were prepared with a light water mist applied to the MRE/MRX and the PLA applied to the Kapo Board. However, this yielded unfavourable results and so the above method was used.

5. SAMPLE CONDITIONING:

5.1. Un-conditioned Samples:

Samples left at typical room conditions.

5.2. Freeze-Thaw Conditioned Samples:

Samples underwent conditioning using BEAL's freeze-thaw unit comprising of 3 hours at 70°C followed by 3 hours switched off, 3 hours at -20°C and a further 3 hours switched off. This process is repeated 20 times in total, over 10 days.

6. TEST CONDITIONS:

6.1. Samples were tested at room temperature 23°C ± 3°C.

6.2. Jaw separation rate was set to 4 mm/minute.

6.3. A minimum of five sample specimens were tested per set.

7. TEST EQUIPMENT:

7.1. Tinius Olsen Tensile Testing Machine H5KS (IANZ based calibration).

7.2. BEAL Freeze/Thaw Conditioning Unit.

8. QUANTITATIVE RESULTS:

8.1. Kapo Board Adhered to MAXRaft E with PLA – Un-conditioned:

Sample ID	Area (mm ²)	Max Force (N)	Max Stress (MPa)
S440-1	2652	1088	0.41
S440-2	2601	1048	0.40
S440-3	2550	947	0.38
S440-4	2550	977	0.38
S440-5	2499	972	0.39
Average		1007	0.39
Standard Deviation		59	0.02

-See 9.1. for failure mode.

8.2. Kapo Board Adhered to MAXRaft E with PLA – F-T Conditioned:

Sample ID	Area (mm ²)	Max Force (N)	Max Stress (MPa)
S441-1	2500	946	0.38
S441-2	2550	831	0.33
S441-3	2601	719	0.28
S441-4	2450	891	0.36
S441-5	2499	662	0.27
Average		0.810	0.32
Standard Deviation		118	0.05

-See 9.2. for failure mode.

8.3. Stone Adhered to Concrete Block – Un-conditioned:

Sample ID	Area (mm ²)	Max Force (N)	Max Stress (MPa)
S439-1	2450	257	0.11
S439-2	2500	292	0.12
S439-3	2500	350	0.14
S439-4	2500	351	0.14
S439-5	2450	304	0.12
Average		311	0.13
Standard Deviation		40	0.02

-See 9.3. for failure mode.

9. OBSERVATIONS:

9.1. Sample S440 – Kapo Board to MRE (Un-conditioned):

In all specimens failure occurred in MRE (EPS) substrate, with the exception of S440-5, which demonstrated the same failure as described in 9.2.

-See 11.4 for photo.

9.2. Sample S441 – Kapo Board to MRE (Conditioned):

In all specimens failure occurred in the Kapo Board substrate. A thin layer of Kapo Board was separated from the PLA side of the main piece of Kapo Board.

-See 11.5 for photo.

9.3. Sample S439 – Kapo Board to MRX (Un-conditioned):

In all specimens failure occurred in the MRX (XPS) substrate.

-See 11.6 for photo.

10. CONCLUSION:

10.1. Uroxsys' Panel Laminating Adhesive has met the criteria set out on 3.1. Thus is deemed to have satisfactory adhesive capabilities to the Kapo Board, MAXRaft E and MAXRaft X.

11. ATTACHMENTS – Graph Results & Photos (next page):

Authorised signatory,



Matthew van den Tillaart
Building Technician

Colin R. Prouse
Principle Building Scientist

Building Element Assessment Laboratory Limited

11.1. Kapo Board Adhered to MRE, Graph Results – Un-conditioned:



TR150314-3
 Flatwise Tensile - Kapo Board Adhered to EPS with
 Uroxsys Panel Laminating Adhesive
 - Un-conditioned



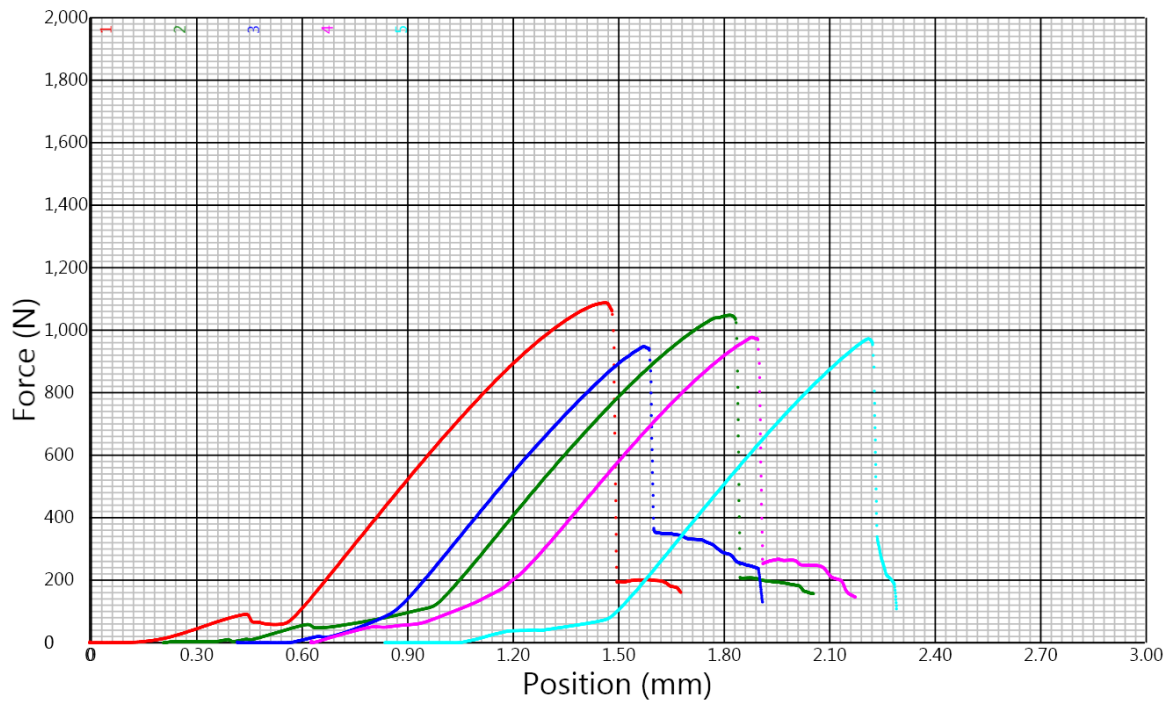
Client: Maxraft
 Job Number: BTS1518
 Sample Designation: S440
 Tested by: M. van den Tillaart

Method Name: BEAL Tensile on Horizontal (Flatwise)
 Standard: ASTM C297
 Test Speed: 4.00 mm/min
 Batch Start Date and Time: 11/05/2015 3:00 p.m.
 Graph Offset: 5.00 %

Sample Number	Area mm ²	Max Force N	Ultimate Stress MPa	Break Distance mm
1	2652	1,088	0.410	1.68
2	2601	1,048	0.403	1.85
3	2550	947	0.372	1.49
4	2550	977	0.383	1.55
5	2499	972	0.389	1.45
Average		1,007	0.391	
SD		58.8	0.0154	

Comments:

- In all samples, failure occurred in the EPS Substrate.



BEAL Tensile on Horizontal (Flatwise) (Ver. 1)
 v10.0.12.1 - 605745GB - BEAL (Building Element Assessment Laboratory)

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BEAL Tensile on Horizontal (Flatwise) (rev. 80)
 HSK : 5000N. Printed: 20/05/2015 1:56 p.m.

11.2. Kapo Board Adhered to MRE, Graph Results – F-T Conditioned:



TR150314-3

Flatwise Tensile - Kapo Board Adhered to EPS with Uroxsys Panel Laminating Adhesive - Freeze-Thaw Conditioned



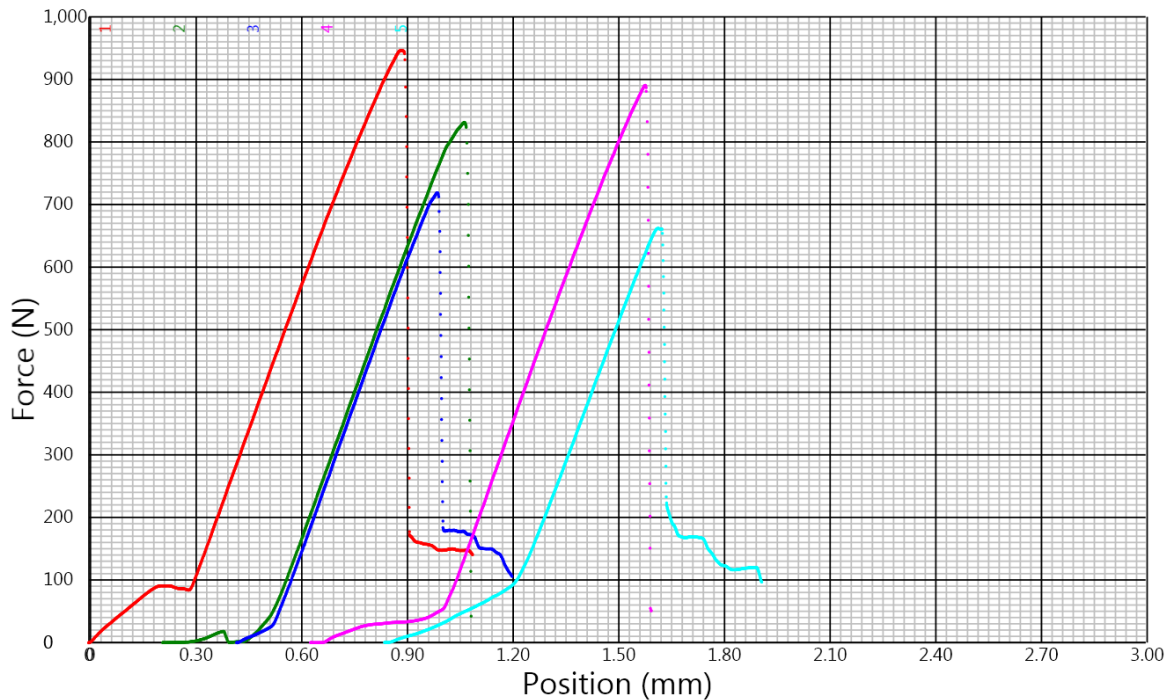
Client: Maxraft
 Job Number: BTS1518
 Sample Designation: S441
 Tested by: M. van den Tillaart

Method Name: BEAL Tensile on Horizontal (Flatwise)
 Standard: ASTM C297
 Test Speed: 4.00 mm/min
 Batch Start Date and Time: 19/05/2015 10:38 a.m.
 Graph Offset: 5.00 %

Sample Number	Area mm ²	Max Force N	Ultimate Stress MPa	Break Distance mm
1	2500	946	0.378	1.09
2	2550	831	0.326	0.88
3	2601	719	0.276	0.78
4	2450	891	0.363	0.97
5	2499	662	0.265	1.07
Average		810	0.322	
SD		118	0.0507	

Comments:

- In all samples, failure occurred in the Kapo Board Substrate.



BEAL Tensile on Horizontal (Flatwise) (Ver. 1)
 v10.0.121 - 605745GB - BEAL (Building Element Assessment Laboratory)

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BEAL Tensile on Horizontal (Flatwise) (rev. 79)
 HSKS/06 : 5000N. Printed: 19/05/2015 11:15 a.m.

11.3. Kapo Board Adhered to MRX, Graph Results – Un-conditioned:



TR150508-1
 Flatwise - XPS bonded to Kapo board with
 Uroxsys panel laminating adhesive- unconditioned



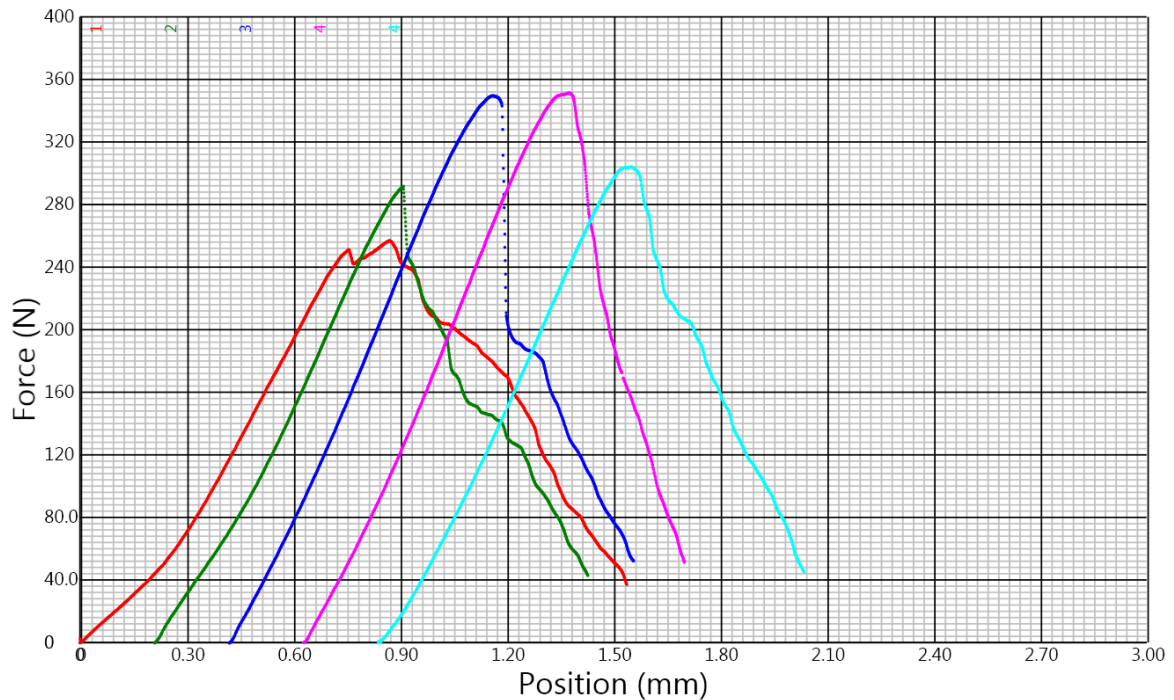
Client: Maxraft
 Job Number: BTS1518
 Sample Designation: S439
 Tested by: L. Presto

Method Name: BEAL Tensile on Horizontal (Flatwise)
 Standard: ASTM C297
 Test Speed: 4.00 mm/min
 Batch Start Date and Time: 8/05/2015 10:02 a.m.
 Graph Offset: 5.00 %

Sample Number	Area mm ²	Max Force N	Ultimate Stress MPa	Break Distance mm
1	2450	257	0.105	1.54
2	2500	292	0.117	1.22
3	2500	350	0.140	1.14
4	2500	351	0.141	1.07
4	2450	304	0.124	1.20
Average		311	0.125	
SD		40.1	0.0153	

Comments:

- In all cases the internal bond strength of the XPS gave out before any failure in the adhesion strength of the Uroxsys panel laminating adhesive.



BEAL Tensile on Horizontal (Flatwise) (Ver. 1)
 v10.0.12.1 - 605745GB - BEAL (Building Element Assessment Laboratory)

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BEAL Tensile on Horizontal (Flatwise) (rev. 76)
 HSKS/06 : 5000N. Printed: 8/05/2015 10:39 a.m.

11.4. Kapo Board Adhered to MRE, Typical Failure – Un-conditioned:



11.5. Kapo Board Adhered to MRE, Typical Failure – Conditioned:



11.6. Kapo Board Adhered to MRX, Typical Failure – Un-conditioned:

